

WHAT IS CLAIMED IS:

1. A motor driving apparatus for driving a linear vibration motor having a mover which is reciprocatably provided and a spring member which supports the mover, including:

a motor driver having an operating mode for applying a driving voltage to the linear vibration motor so as to activate an operation of the motor, and a non-operating mode for applying a DC voltage to the linear vibration motor so as to generate a thrust of the mover;

a thrust information output unit for outputting thrust information indicating the thrust of the mover, which is generated by the application of the DC voltage to the linear vibration motor;

a thrust constant calculation unit for calculating a motor thrust constant of the linear vibration motor by performing an arithmetic operation of dividing the thrust indicated by the thrust information, by a DC current that is supplied to the linear vibration motor due to the application of the DC voltage to the linear vibration motor; and

a mover position calculation unit for performing position calculation for obtaining the position of the mover on the basis of the calculated motor thrust constant.

2. The motor driving apparatus as defined in Claim 1 further including:

a moving distance detection unit for detecting a distance

by which the mover has moved as a result of the application of the DC voltage to the linear vibration motor, and

said thrust information output unit deciding the mover thrust that is generated by the application of the DC voltage to the linear vibration motor, according to an arithmetic operation of multiplying the moving distance of the mover detected by the moving distance detection unit, by a spring constant of the spring member, and outputting thrust information which indicates the decided mover thrust.

3. The motor driving apparatus as defined in Claim 1 further including:

a mover position detection unit that, when the mover has arrived at a prescribed position that is a predetermined distance away from a neutral position in which a spring force of the spring member does not act on the mover, outputs a detection signal indicating that the mover has arrived at the prescribed position, wherein

when receiving the detection signal, said thrust information output unit outputs the thrust information indicating the mover thrust that is balanced with the spring force of the spring member, which is generated by the application of the DC voltage to the linear vibration motor and acts on the mover that is located at the prescribed position.

4. The motor driving apparatus as defined in any of Claims 1 to 3 wherein

said motor driver temporarily changes its mode to the non-operating mode at a start of the operation of the linear vibration motor so as to calculate the motor thrust constant, and

said mover position calculation unit performs the position calculation for obtaining the mover position during the operation of the linear vibration motor using the motor thrust constant calculated in the non-operating mode at the start of the operation of the linear vibration motor.

5. The motor driving apparatus as defined in any of Claims 1 to 3 wherein

said motor driver temporarily changes its mode to the non-operating mode at an end of the operation of the linear vibration motor so as to calculate the motor thrust constant, and

said mover position calculation unit performs the position calculation for obtaining the mover position during the operation of the linear vibration motor using the motor thrust constant calculated in the non-operating mode at the end of the previous operation.

6. The motor driving apparatus as defined in any of Claims 1 to 3 further including:

a temperature detection unit for detecting a temperature

of the linear vibration motor; and

a motor thrust constant estimation unit for estimating a motor thrust constant that is used at the position calculation for obtaining the mover position during the operation of the linear vibration motor, on the basis of the motor thrust constant calculated by the thrust constant calculation unit and the temperature detected by the temperature detection unit, wherein

said motor driver temporarily changes its mode to the non-operating mode at a start or end of the operation of the linear vibration motor, or at the start and end of the operation, so as to calculate the motor thrust constant,

said motor thrust constant estimation unit,

when the linear vibration motor is not operating, derives a relationship between the temperature of the linear vibration motor and the motor thrust constant on the basis of the motor thrust constant calculated in the non-operating mode and the temperature at that calculation of the motor thrust constant, detected by the temperature detection unit, and

when the linear vibration motor is operating, estimates the motor thrust constant in the operating state of the linear vibration motor, from the derived relationship between the temperature of the linear vibration motor and the motor thrust constant on the basis of the temperature detected by the temperature detection unit, and

said mover position calculation unit performs the position

calculation for obtaining the mover position during the operation of the linear vibration motor, using the estimated motor thrust constant.

7. An air conditioner provided with a compressor which has a cylinder and a piston, and compresses a liquid in the cylinder by a reciprocating motion of the piston, including:

a linear vibration motor for making the piston reciprocate, having a mover which is reciprocatably provided, and a spring member which supports the mover;

a motor driving unit for driving the linear vibration motor;

and

said motor driving unit being a motor driving apparatus as defined in any of Claims 1 to 6.

8. A refrigerator provided with a compressor which has a cylinder and a piston, and compresses a liquid in the cylinder by a reciprocating motion of the piston, including:

a linear vibration motor for making the piston reciprocate, having a mover which is reciprocatably provided, and a spring member which supports the mover;

a motor driving unit for driving the linear vibration motor;

and

said motor driving unit being a motor driving apparatus as defined in any of Claims 1 to 6.

9. A cryogenic freezer provided with a compressor which has a cylinder and a piston, and compresses a liquid in the cylinder by a reciprocating motion of the piston, including:

a linear vibration motor for making the piston reciprocate, having a mover which is reciprocatably provided, and a spring member which supports the mover;

a motor driving unit for driving the linear vibration motor;  
and

said motor driving unit being a motor driving apparatus as defined in any of Claims 1 to 6.

10. A hot-water supply unit provided with a compressor which has a cylinder and a piston, and compresses a liquid in the cylinder by a reciprocating motion of the piston, including:

a linear vibration motor for making the piston reciprocate, having a mover which is reciprocatably provided, and a spring member which supports the mover;

a motor driving unit for driving the linear vibration motor;  
and

said motor driving unit being a motor driving apparatus as defined in any of Claims 1 to 6.

11. A handy phone provided with a linear vibration motor for generating vibration, and a motor driving unit for driving the

linear vibration motor, including:

said linear vibration motor having a mover which is reciprocatably provided, and a spring member which supports the mover; and

said motor driving unit being a motor driving apparatus as defined in any of Claims 1 to 6.